alteration of the formula used for the determination of the transparency of the atmosphere, was reversed in its course.

Summarizing these considerations, we can say that from the data at hand it can not be concluded with certainty that an 11-month period exists. For this the material available is too scanty. So long, however, as the 11-month period can not with certainty be proved, it is more reasonable to interpret the facts of observation as an annual variation resulting from terrestrial influences, where the discontinuity of 1925 is caused by the alteration in the reckonlng of the transparency, than to assume an 11-month period for which there is no physical explanation whatsoever.

THE CHANGE OF HUMIDITY INCIDENT TO A THUNDERSTORM

By W. J. HUMPHREYS

Anyone who has seen sheets of rain in a thunderstorm vanish wholly before reaching the surface, as they often do in an arid region, and who also has experienced the drop in temperature that accompanies the rain when it does fall to the ground, is quite ready to believe that the relative humidity must increase with the onset of such a shower. And this is just what does happen as the books tell us and the records show.

But how does the absolute humidity, more important than relative humidity in some respects, change with the progress of the storm? The answer to that question, which has been raised in connection with certain lightning-protection problems, is not in the books, nor in the journals either, so far as I could find in a brief search. Recourse therefore was had to original data. Mr. G. E. Dunn, of the forecast division of the Weather Bureau, selected for me a number of typical heat thunderstorms and an equal number of cold-front storms. Then the automatic humidity record of each of these, extending from before its beginning to after its close, was looked up by the division of climatology, Mr. J. B. Kincer in charge.

It was found that (1) in heat thunderstorms the absolute humidity *increases* with the onset of the rain by, say, 15 to 20 per cent, or, roughly, 1 grain of vapor per cubic foot, or 2¼ grams per cubic meter, and (2) that in cold-front thunderstorms the absolute humidity *decreases* in more or less the same proportion, that is, in the order of 1 grain of vapor per cubic foot.

The obvious explanations of these phenomena are:

a. In the case of the heat thunderstorm, since the absolute humidity of the air is approximately the same on all sides of it, therefore the evaporation of the falling rain necessarily increases the vapor density, as does also the contraction due to decrease of temperature, above that either before the onset of the shower or a while after its passage.

b. The distribution of the absolute humidity about the cold-front thunderstorm, however, is quite unequal. It is much greater in the warm air in front of the storm than it is in the cold air to the rear. Here, although the absolute humidity of the air through which the rain is falling necessarily is increased, by virtue of the evaporation that occurs and the decrease of temperature, this gain ordinarily is not enough to raise the vapor content of the oncoming dry air up to, much less above, that of the warm humid air in front of the squall. Hence, in the cold-front thunderstorm the absolute humidity generally decreases with the onset and progress of the storm.

WEATHER TYPES OF THE NORTHEAST PACIFIC OCEAN AS RELATED TO THE WEATHER OF THE NORTH PACIFIC COAST

By THOMAS R. REED

[Weather Bureau, San Francisco, Calif., 1932]

The weather types of the northeast Pacific Ocean are so closely related to the general wind systems of that region that any discussion of them must be predicated on an understanding of what these wind systems normally are and the changes in weather types that changes or disruptions in the normal wind systems bring about. These wind systems correspond in a general way to those found in similar latitudes in the North Atlantic Ocean and may be inferred from the so-called centers of action with which they are associated. One of these centers of action is the semipermanent high which is usually at its maximum between northern California and Hawaii, and the other is the semipermanent low usually somewhere to the northwestward of it. The low reaches its maximum development in winter when the wind systems which accompany it are strongest. The high reaches its maximum in summer due in part to the accumulation of air ejected from the continents of the northern hemihemisphere at that time of year.

It is sometimes convenient to refer to these so-called centers of action as though they were causative and responsible for the wind systems about them, but for practical purposes such as weather forecasting or the analysis of weather types it is helpful to recognize them more often as effect than cause and to see in them the indirect but substantial evidence of the set and strength of the accompanying wind systems. In the words of Sir Napier Shaw—

> Instead of looking to the centers of high and low pressure as controlling powers, I should propose to regard them as created by the distribution of currents which they have been supposed to control. * * * Thus in the free air low pressure and high pressure, depression and anticyclone, are the marginal effects of the flow of an air current in order to adjust the gradient to the current; the particular shape and intensity of the low and high are conditioned by the distribution of currents in the field.[1]

When the high is of ordinary or more than ordinary strength, the orientation of its major axis is the best clue to the classification of the prevalent weather type. When the high is insignificant, the predominant set of the isobars in the low has to be relied on for this purpose. Similar logic governs the interpretation of the weather chart in either case, for whether we are looking at the axis of the high or, in its absence, at the general trend of isobars in the low, we are interpreting the pressure situation which

[1] Quarterly Journal of the Royal Meteorological Society, Oct. 1931, pp. 460, 463.